

REMARKS

The Office Action of August 9, 2007 has been received and carefully reviewed. It is submitted that, by this Amendment, all bases of rejection are traversed and overcome. Upon entry of this Amendment, claims 1-13, 15-18 and 34-48 remain in the application. New claim 49 has been added in order to set forth an additional specific embodiment that the Applicants regard as their invention. Support for this new claim may be found throughout the specification as filed, at least at paragraphs [0005], [0017] and [0026] and in Figures 3A-3C. Reconsideration of the claims is respectfully requested.

Claims 1-13 and 15-18 stand rejected under 35 U.S.C. § 103(a) as being obvious over Sasahara (U.S. Patent Publication No. 2002/0012825) in view of Chou (U.S. Patent No. 5,772,905) and Zhang (Doctor of Philosophy dissertation, Princeton University, Nov. 2001). Claims 34-48 stand rejected under 35 U.S.C. § 103(a) as being obvious over Sasahara in view of Chou.

The Examiner states that Sasahara teaches the elements of claim 1 except for the mold, and steps of making of the mold. The Examiner further states that Chou teaches such a mold and how the mold is used to form recesses in a membrane. The Examiner asserts that Chou's imprinting process is a suitable substitute for Sasahara's embossing method (and recites various papers in support thereof).

Regarding claims 1-13 and 15-18, the Examiner also states that Zhang teaches a general process to fabricate NIL masks, which are used to form molds. The Examiner concludes that it would have been obvious to combine the various references and arrive at Applicants' invention as defined in the previously pending claims.

Applicants have amended independent claims 1 and 34 to include that the recess side walls remain substantially free of catalytic material, and to include the step of chemically bonding, via laser heat application, oxidation or reduction, the layer of catalytic material to the top surface of the membrane and to the bottom of the at least one recess. Support for these recitations may be found throughout the specification as filed, particularly in paragraphs [0005] and [0034], and in Fig. 4B.

None of the cited references (i.e., Sasahara, Chou and Zhang), alone or in combination, teach or suggest that a catalytic material is established on the top and bottom of the recesses (while the side walls remain substantially free of such material), and that the catalytic material is chemically bonded to the membrane at the respective top and bottom surfaces.

Sasahara teaches that a catalytic material may be established **at the interfaces** between the electrodes and the electrolyte. As shown in Fig. 2 of Sasahara (reproduced hereinbelow), such interfaces 38, 40 extend along the top of the electrolyte, the bottom of the electrolyte, and along the side walls of the electrolyte. As such, the catalytic material of Sasahara (shown as 164 in Fig. 12, also reproduced hereinbelow) is established conformally along the top of the electrolyte, the bottom of the electrolyte, and along the side walls of the electrolyte. This is in sharp contrast to Applicants' invention as defined in amended independent claims 1 and 34, in which the side walls of the recesses remain substantially free of catalytic material. Furthermore, it is submitted that it would not be obvious to remove the catalytic material of Sasahara from the side walls, as Sasahara clearly establishes that such material is desirable along the entire interface 38, 40.

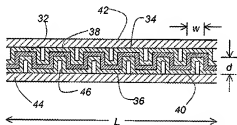


FIG. 2

Figure 2 of Sasahara

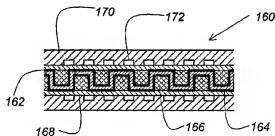


FIG. 12

Figure 12 of Sasahara

Furthermore, Sasahara does not teach or suggest, or even mention, that the catalytic material is subjected to further chemical bonding processes, as recited in Applicants' amended claims.

It is submitted that Chou does not supply the deficiencies of Sasahara regarding the catalytic material deposition and further processing. Although Chou discloses that a material (e.g., an electrical conductor) may be established on the dams 26 and into the recesses 28 (see Figure 5A of Chou, reproduced hereinbelow), he **also** discloses that the material 30 and the dams 26 are removed to form elements 32 (e.g., integrated circuits) on the surface of the substrate 18. (See Col. 5, lines 47-60.) Chou never states that the material 30 is chemically bonded to the dams 26 or to the substrate surface. In fact, it is submitted that Chou actually *teaches away* from chemically bonding the material 30, in part because portions of such material are ultimately removed from the device.

Fig. 5A

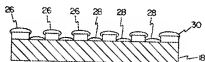


Fig. 5B



Figures 5A and 5B of Chou

It is further submitted that Zhang does not supply the deficiencies of the Sasahara and Chou references. As such, Applicants submit that none of the cited references teaches or suggests 1) establishing the catalyst material such that the side walls are substantially material free **and** 2) chemically bonding the layer of catalytic material to both the top surface of the membrane and to the bottom of the at least one recess.

Based on the amendment to independent claims 1 and 34, and for all of the reasons provided hereinabove with respect to Sasahara, Chou and Zhang, it is submitted

that the Applicants' invention as defined in amended claims 1 and 34, and in those claims depending therefrom, is not taught, anticipated, or rendered obvious in view of Sasahara, Chou or Zhang, either alone or in any combination, and patentably define over the art of record.

New claim 49 recites:

49. A method of making nanoscale catalyst patterns for an ion exchange membrane, comprising:
providing a mold having a top surface;
establishing at least one nanoscale masking element on at least a portion of the top surface;
etching exposed portions of the mold to form at least one nanoscale protrusion therein;
pressing the at least one nanoscale protrusion into *an unpatterned top surface* of the membrane to form *a single set of nanoscale recesses, each of the nanoscale recesses having a dimension ranging from about 1 nm to about 20 nm*, each nanoscale recess having a bottom and side walls extending from the top surface of the membrane to the bottom of the at least one recess; and
depositing, *without subsequently removing*, a layer of catalytic material on the top surface of the membrane and the bottom of the at least one recess such that the side walls remain free of catalytic material. (emphasis added).

Support for this new claim may be found throughout the specification as filed, at least in original claims 1 and 32, paragraphs [0005], [0017], [0026] and [0034], and in Figures 1A-1C, 3A-3C and 4B.

As set forth above, new claim 49 recites, in part, "pressing the at least one nanoscale protrusion into *an unpatterned top surface* of the membrane to form *a single set of nanoscale recesses, each of the nanoscale recesses having a dimension ranging from about 1 nm to about 20 nm.*" This is in sharp contrast to Sasahara, which teaches (in paragraph [0039]) forming three-dimensional mesoscale features having a width between "5 and 500 μm ," and a depth between "1 μm and 5 min [sic]", and forming nanoscale features on the mesoscale features. Sasahara is forming two sets of features, one of which (i.e., the mesoscale features) is suitable for reactant flow, and the

other of which (i.e., the nanoscale features) is suitable for surface area **enhancement** of the mesoscale features. This is clearly shown in Fig. 8 of Sasahara. As such, Sasahara does **not** form a **single set of** nanoscale features in an unpatterned top surface as defined in Applicants' new claim 49.

While Chou does teach the formation of a single set of nanoscale features, it is submitted that one skilled in the art would not be led to remove the mesoscale features of Sasahara for the nanoscale features of Chou, as neither of the references teach or suggest that features ranging from 1 nm to 20 nm are suitable for reactant flow (i.e., the stated purpose of the Sasahara mesoscale features). If one were to substitute Chou's nanoscale features for the mesoscale features of Sasahara, the stated purpose of Sasahara would likely be destroyed. As such, it is submitted that one skilled in the art would not likely combine Chou and Sasahara.

Furthermore, as set forth hereinabove, Sasahara does not teach or suggest that a catalyst material layer is established such that side walls are substantially free of such material. Rather, Sasahara teaches **conformal** deposition of the catalyst material.

Chou does not supply the deficiency of Sasahara in this regard. Chou does not teach that a catalytic material is deposited, *without subsequent removal*, on the top surface of the membrane and the bottom of the at least one recess such that the side walls remain free of catalytic material. In fact, as set forth above, Chou specifically removes the material and the dams to form circuitry. As such, neither Sasahara nor Chou teach or suggest "depositing, *without subsequently removing*, a layer of catalytic material on the top surface of the membrane and the bottom of the at least one recess such that the side walls remain free of catalytic material", as recited in Applicants' new claim 49.

For all the reasons stated above, it is submitted that Applicants' invention as defined in new claim 49 is not anticipated, taught or rendered obvious in view of Sasahara or Chou, alone or in combination with any of the other cited references, and patentably defines over the art of record.

In summary, claims 1-13, 15-18 and 34-48 remain in the application. New claim 49 has been added herein. It is submitted that, through this amendment, Applicants' invention as set forth in these claims is in a condition suitable for allowance.

Further and favorable consideration is requested. If the Examiner believes it would expedite prosecution of the above-identified application, he is cordially invited to contact Applicants' Attorney at the below-listed telephone number.

Respectfully submitted,

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